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GB 1291978	GB 1249944	GB 1147262
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(58) Field of search
F1F
Selected US specifications from IPC sub-classes
F01C F03C F04C

(54) Rotary vane-type machine

(57) The machine, which may be a motor or a pump, comprises a rotor 4 provided with spring-loaded radially-displaceable vanes 5. The vanes abut against a cam surface 8 on cam ring 1. In order to provide a variable volume machine, the cam ring 1 includes a radially-movable adjusting segment 2 in the area between an inlet opening 7 and an outlet opening 3. The adjusting segment may be operated mechanically by a lever or by an adjustable cam plate, or hydraulically by a differential piston (2,Fig.4) controlled by a system responsive to the variation between actual and rated speeds (Fig.6).

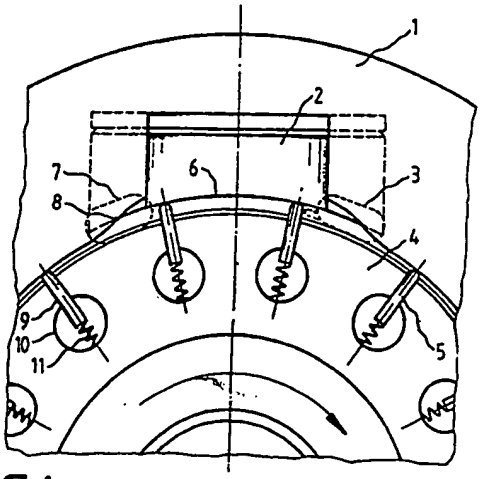

FIG.1

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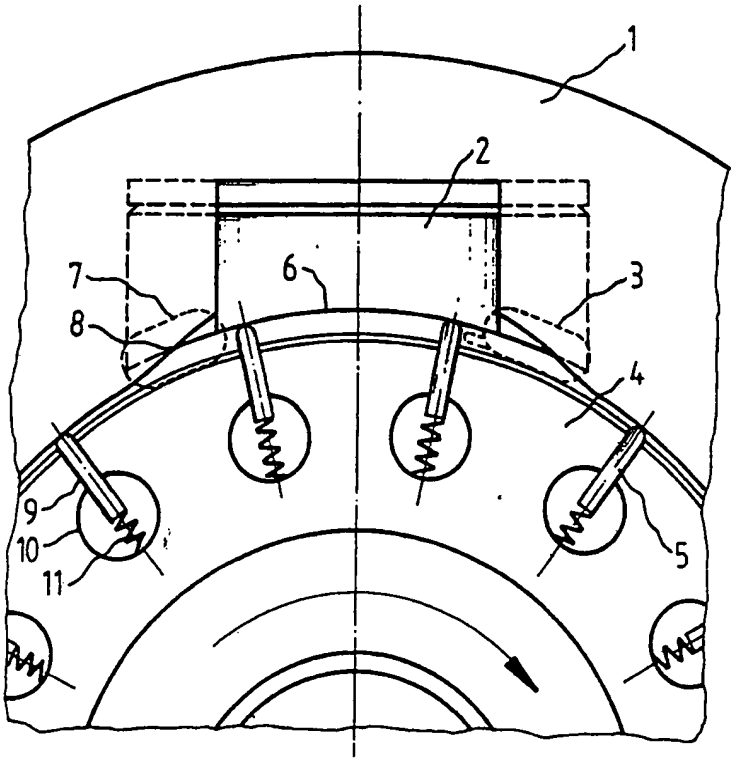
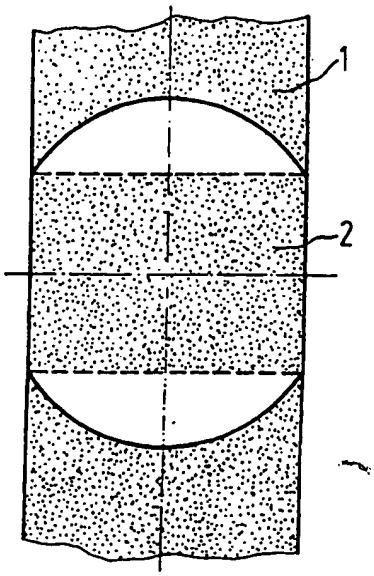


FIG.1

FIG.3



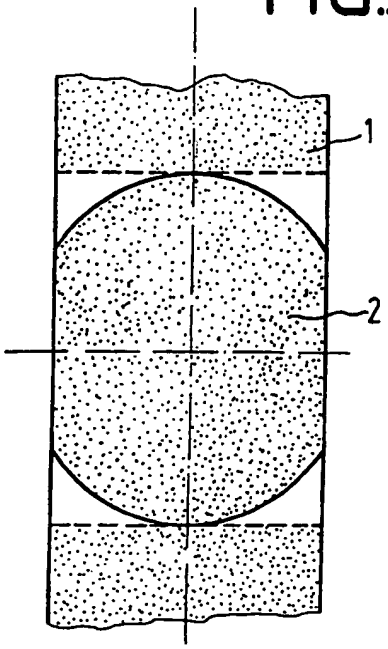


FIG.2

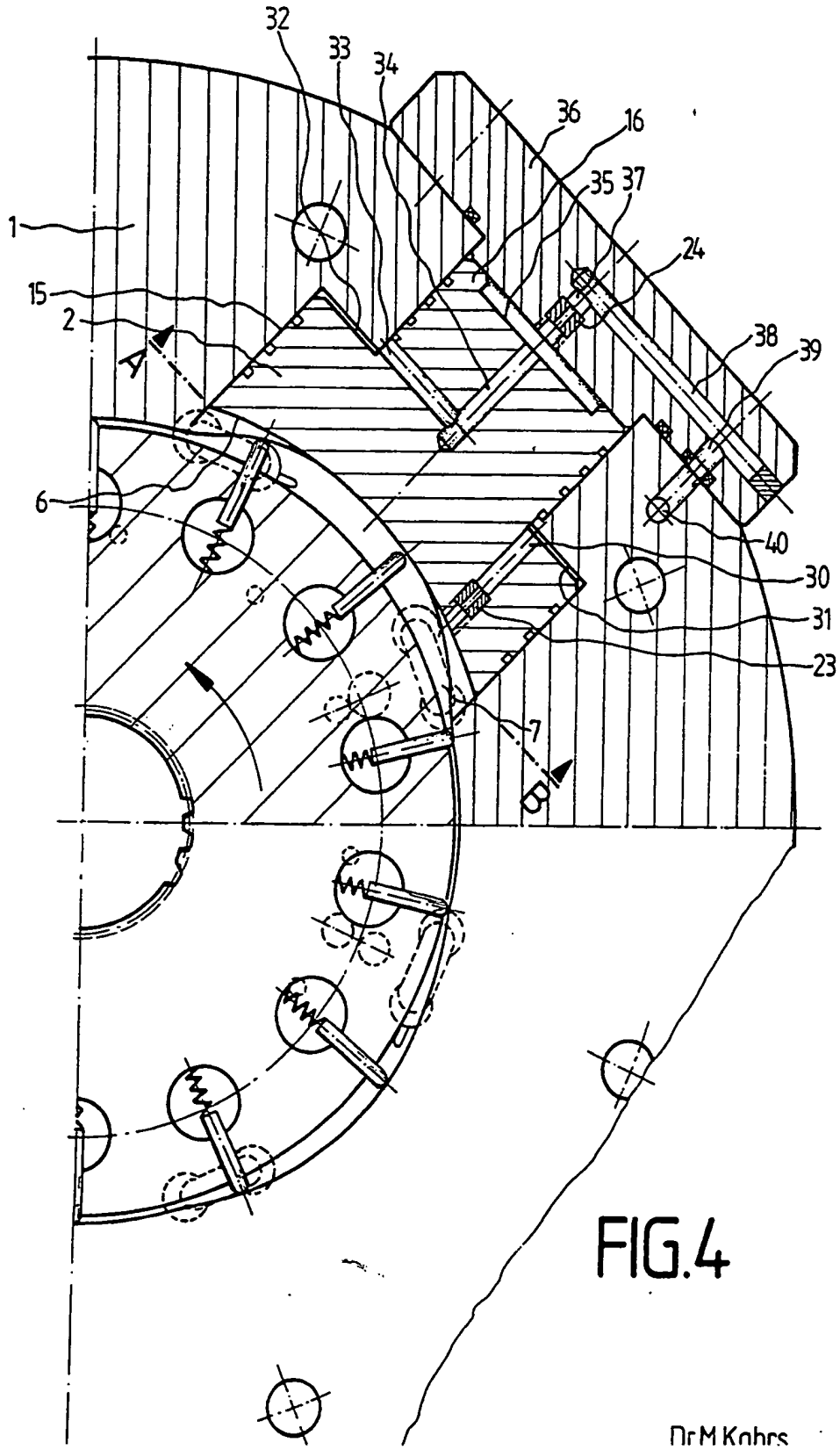


FIG.4

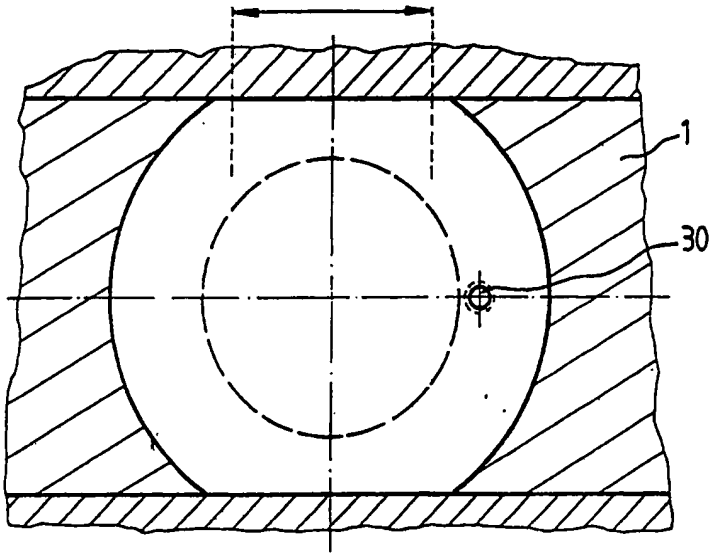


FIG.5

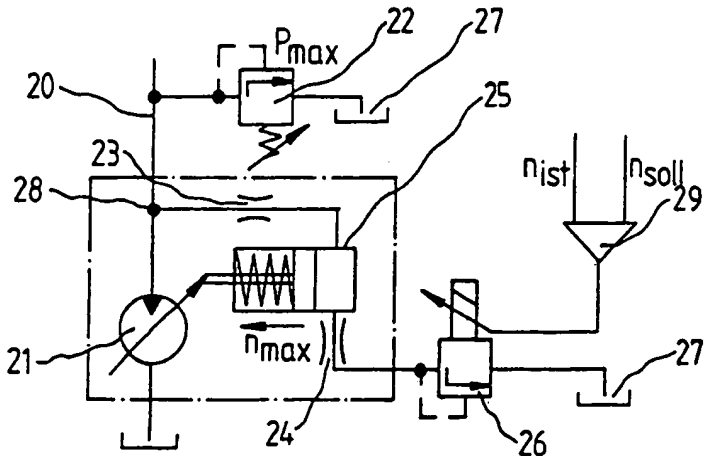


FIG.6

VANE-TYPE MACHINE

The present invention relates to a vane-type machine comprising an inlet opening and an outlet opening a rotor at whose periphery radially-extending slots are provided in which radially-displaceable vanes are arranged, a cam ring on whose cam surface the vanes are abutting with their edge projecting from the rotor and lateral parts which confine the working compartments in an axial direction.

Known vane-type machines of this kind either comprise a centrically-supported rotor, with preferably several working chambers being arranged symmetrically distributed over the periphery for compensating the radial bearing force components; moreover the structural dimensions of the vane-type machine are utilized several times or they may comprise a rotary piston which is eccentrically accommodated in a circular cam ring, the piston's eccentricity being variable. Although the last-mentioned vane-type pumps bear the advantage that their volume of delivery is adjustable in dependence upon the eccentricity between the ring and the rotor, they suffer from the shortcoming that the radial forces acting on the rotor and thus on the bearings are out of balance, what necessitates a complicated and costly bearing.

Vane-type machines with a centrically-supported rotor include for instance an oval ring (two

oppositely disposed working chambers) as sliding surface of the vanes and normally are designed as machines with a constant absorptive volume. However, likewise multi-chamber systems are known, wherein respectively opposed working chambers can be connected or disconnected in pairs by means of a control slide. Yet, the adjustment of the absorptive volume takes place in steps therein.

Therefore, it is an object of the present invention to devise a vane-type machine of the kind referred to whose absorptive volume is infinitely variable and wherein the structural dimensions of the vane-type machine are utilized optimally.

According to the invention there is provided a vane-type machine comprising an inlet opening and an outlet opening a rotor at whose periphery radially-extending slots are provided in which radially-displaceable vanes are arranged, a cam ring on whose cam surface the vanes are abutting with their edge projecting from the rotor and lateral parts which confine the working compartments in an axial direction, characterised in that the cam ring has a radially-movable adjusting segment between the inlet opening and the outlet opening.

The preferred field of application of a vane-type machine according to the invention is to be seen in its use as a vane-type motor whose number of revolutions or torque can be infinitely variably adjusted this way. It is of course also possible to use it in the capacity of a pump.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a cross-section taken through a vane-type motor according to a first embodiment,

Figure 2 is a view on the sliding surface of the vanes with a maximum absorptive volume,

Figure 3 is a view on the sliding surface of the vanes with a minimum absorptive volume,

Figure 4 is a cross-section taken through a second embodiment of a vane-type motor having a hydraulically-actuatable adjusting segment,

Figure 5 is a cross-section taken along the line A-B of Figure 4.

Figure 6 is a schematic wiring diagram for the speed control of a vane-type motor according to Figure 4.

The vane-type motor shown in Figure 1 comprises a rotor 4 which is centrically accommodated inside a cam ring 1 and which is supported in the lateral housing flanges. At its outer periphery, said rotor 4 is furnished with radially-extending slots 9 in which radially-slidable vanes 5 are disposed. These vanes 5 are preloaded radially outwardly against the cam ring 1 by means of compression springs 11 which are arranged inside the bore of the vanes' inner ends 10.

In the area between the inlet opening 7 and the outlet opening 3, the cam ring 1 includes a recess which is confined by the radially-outwardly extending cam curve 8. Said inlet opening 7 and said outlet opening 3 are incorporated in one of two (non-illustrated) side plates which are in sealing abutment on the rotor 4 and the vanes 5 and which axially bound the working chambers of the motor.

Likewise in the area between the inlet opening 7 and the outlet opening 3, an adjusting segment 2 is fitted into the cam ring, its side close to the rotary piston 4 showing a projecting curve 6. This projecting curve 6 is formed by the concave end

surface of the adjusting segment 2 designed as a piston. The actuation of the adjusting segment 2 can be effected e.g. mechanically by a (non-illustrated) lever tiltably articulated at the cam ring 1 and including a control curve which engages at the outwardly directed end surface of the adjusting segment 2.

The infinitely variable adjustability of the adjusting segment 2 allows the number of revolutions or the delivered torque of the motor to be infinitely varied. In this arrangement, the adjusting segment 2 is able to assume any position desired between the two dead centres. The sliding surface traversed by the vanes 5 is shown in Figure 2 for the case of maximum absorptive volume and in Figure 3 for the case of minimum absorptive volume. When the vane-type motor is adjusted to minimum absorptive volumes, the adjusting segment 2 is disposed in its radially inner dead centre, and the cam curve 8 is traversed by the vanes 5 only in a smaller angular range. In contrast thereto, a larger portion of the cam curve 8 is part of the sliding surface of the vanes 5 of the vane-type motor at maximum absorptive volumes. Provisions are made by conforming the bend radii of the cam curve 8 and the projecting curve 6 to one another so that the transition between these two curves is a smooth one.

Figure 4 shows a vane-type motor whose adjusting segment 2 is hydraulically adjustable. The basic motor structure corresponds to that of the embodiment according to Figure 1. The adjusting segment 2 furnished with the projecting curve 6 is designed as a stepped piston which is sealedly and radially-displaceably accommodated in a stepped bore

15. The control of the adjusting segment is performed according to the wiring diagram illustrated in Figure 6.

Connected to a connecting line 20 between the non-illustrated pump and the vane-type motor 21 is a pressure-limiting valve 22 which controls the connection between an unpressurised reservoir 27 and the connecting line 20. Via the throttle 23, there is communication between the branch point 28 and the adjusting device 25 which is disposed between this throttle and the further throttle 24. Arranged between the unpressurised reservoir 27 and the throttle 24 is an electromagnetically-actuatable proportional pressure valve 26 through which the adjusting device 25 can be operated. The control commands for the proportional pressure valve 26 result from the respective variation between the actual speed and the rated speed of the vane-type motor, the said speeds being determined in the comparator 29.

Beside the adjusting device (adjusting segment 2), likewise the two throttle points 23 and 24 are integrated in the vane-type motor shown in Figure 4. Throttle 23 is disposed in a longitudinal bore 30 of the adjusting segment 2 which leads from the end surface showing the projecting curve 6 up to the step 31. The longitudinal bore 30 is arranged in the adjusting segment 2 in such a manner that it is placed in the area of the reniform inlet opening 7. Thus, the pressure of the delivery pump is prevailing at the inlet side of the throttle 23. Via the annular chamber 32 formed by the step 31 and the bore 15, the longitudinal bore 30 is in communication with a transverse bore 33 in the smaller step of the adjusting segment 2 which, in

turn, is connected to an axial bore 34. Said axial bore 34 connects the transverse bore 33 with the smaller end surface 35 of the stepped adjusting segment 2.

The stepped bore 15 is confined outwardly by the closure member 36 which is sealedly coupled to the cam ring 1. Contained in the closure member 36 in alignment with the axial bore 34 is the bore 37 in which the throttle 24 is arranged. The end surface 35 exposed to the closure member 36 is provided with a radially-circumferential stop 16. Bore 37 communicates via the connections 38 and 39 with the port 40 which leads to the proportional pressure valve 26.

The proportional pressure valve 26 serves to regulate the pressure acting on the adjusting device of the vane-type motor and thus to control the position of the adjusting segment 2 during operation, whereby the absorptive quantity of the vane-type motor and thus the number of revolutions as well as the torque are determined. In the radially extreme position of the adjusting segment 2, the absorptive volume is at its maximum, the rotational speed is least and the torque is at its maximum.

Figure 5 shows a cross-section taken through Figure 4 along the line A-B, with the arrow indicating the partition of the vanes.

CLAIMS

1. A vane-type machine comprising an inlet opening and an outlet opening a rotor at whose periphery radially-extending slots are provided in which radially-displaceable vanes are arranged, a cam ring on whose cam surface the vanes are abutting with their edge projecting from the rotor and lateral parts which confine the working compartments in an axial direction, characterised in that the cam ring (1) has a radially-movable adjusting segment (2) between the inlet opening (7) and the outlet opening (3).

2. A vane-type machine as claimed in claim 1, characterised in that the adjusting segment (2) is furnished with a projecting curve (6) on its side close to the rotor (4), which curve is conformed to the cam surface (8) of the cam ring (1) in such a fashion that the transition of the sliding surface of the vanes (5) between the cam ring (1) and the adjusting segment (2) is a smooth one.

3. A vane-type machine as claimed in any one of the preceding claims, characterised in that the adjusting segment (2) is infinitely variably adjustable.

4. A vane-type machine as claimed in any one of the preceding claims, characterised in that the adjusting segment (2) is actuatable mechanically via an adjustable cam plate.

5. A vane-type machine as claimed in any one of the preceding claims, characterised in that the adjusting segment (2) is actuatable hydraulically.

6. A vane-type machine substantially as described with reference to the accompanying drawings.